Does the Iranian oil supply matter for the oil prices?

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Abstract

There is an increasing tension between the Iranian Government and the west on an increasingly likely European oil embargo and the Iranian threat to close the Strait of Hormuz. The main question is: What will happen to the international oil prices in the case of shocks in the flow of Iranian oil to the international markets? In this study, we analyze the dynamic relationship between the Iranian oil supply and international oil prices from January 1973 - September 2011, using a modified version of the Granger causality test introduced by Toda and Yamamoto (1995). Our results show that there is no Granger causality between the Iranian oil production and international oil prices. Historical data on the Iranian oil production do not provide any useful information to explain the current and future values of international oil prices. Thus, global oil prices do not follow shocks in the Iranian oil production.

JEL classification: E37, Q32, Q34, Q38, Q43

Keywords: Oil price, Oil production, VAR model, Granger causality, Sanction, Iran

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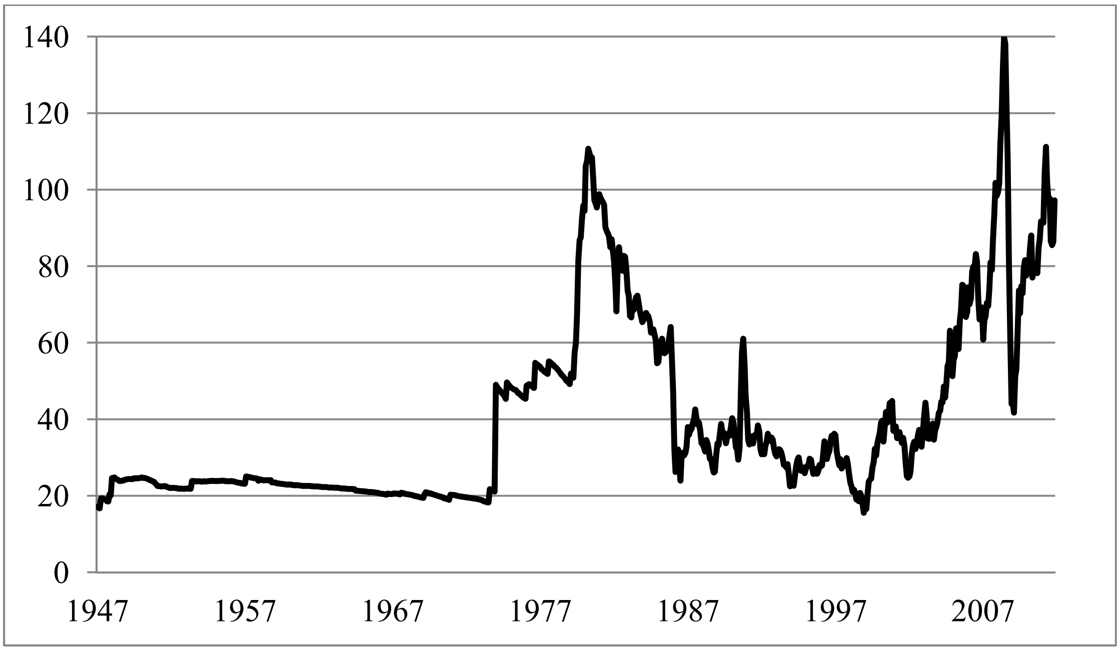
1- Introduction

Figure 1 shows the trend of real oil prices from 1947 to the end of 2011. For more than three decades until 1973, the oil prices have almost been constant at around $20 per barrel (bbl). A series of political and economic shocks increased the oil prices significantly during the 1970s. For the first time, real oil prices reached from $20 to around $100 at the end of the 1970s. Oil markets followed a decreasing trend in the first half of the 1980s reaching its historical low levels of $20 in constant prices. This trend did not change till the end of the 1990s. In the 2000s, we observe a steady increase in oil prices, reaching the historical records of $140 per bbl in 2008. To what extent does the political development in Iran as one of the main oil producers and exporters affect the global oil prices?

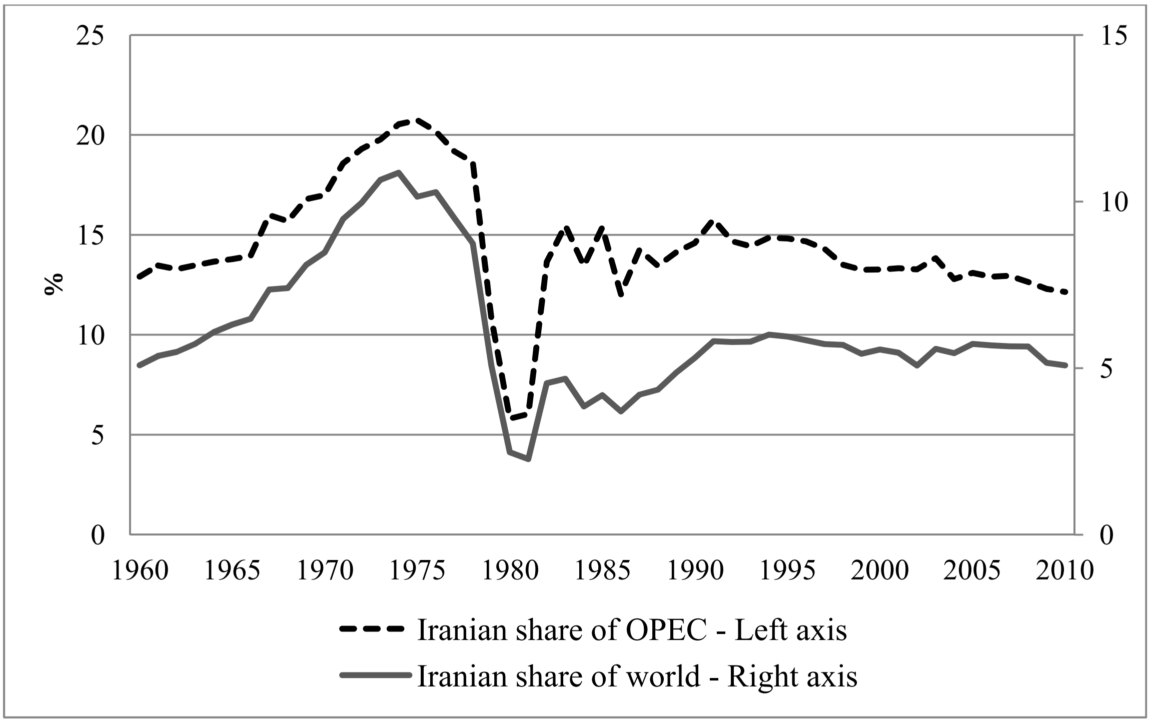
Figure 1. Real price of Crude Oil in November 2011 (Dollars per Barrel)



Note: Monthly average price of West Texas Intermediate divided by ratio of consumer price index for indicated month to consumer price index for November 2011, for 1947:M1 through 2011:M11. Source: FRED (2012).

From 1960-2010, Iran's oil production, on average, comprised 6% and 14% of the world and the OPEC oil production, respectively. Of course, the importance of the Iranian oil production for the global markets was more significant in the 1970s (See Figure 2). The maximum share of Iran's oil production in the world and the OPEC production was 11% and 21% in the mid-70s. This share has decreased to 5% and 12% in 2010, respectively.[1] As long as the export of oil matters, Iran is the 3rd largest oil exporter in the world. The average share of Iran's oil export in world and OPEC oil exports from 1980-2010 were 7% and 12%, while the same figure for Saudi Arabia is 18% and 31%, respectively. Oil plays an important role in the local economy of Iran as well. On average, from 1965 to 2008, the share of oil revenues in total government revenues was approximately 60%, while the share of oil exports in total exports was almost 90% (CBI, 2011).

Figure 2. Share of Iranian Oil Production in World and OPEC



Source: OPEC (2011) and author's calculations

There is an increasing political tension between the Iranian Government and the western countries on the nuclear plans of Iran. The most relevant sanctions, which are designed to affect the Iranian oil supply and revenues, are new oil embargos by the US and the EU, and the U.S. sanctions against Iran's central bank. Both sanctions are directly targeting Iran's oil

[1] To compare, the share of Saudi Arabian oil production in world and OPEC oil production is more than two times the share of Iran (12% and 28% in 2010).

sales, increasing its transaction costs while potentially forcing the country to sell oil at discounted prices (Faucon, 2012).[2] Sanctions against the Iranian central bank introduce new challenges to receive the petrodollars by the Iranian Government. For example, India as one of the main importers of Iranian crude oil has faced serious problems in making payments for crude oil it buys from Iran. The country has used the Turkish banking system for its payments to Iran but the new US sanctions will make the usage of the Turkish channel more problematic.[3] Investments in the oil and gas industry of Iran are also affected by the current energy sanctions. European Union leaders agreed to impose significant sanctions on energy-related investments in Iran on June 2010. The EU sanction mainly aims at the oil and gas industry, prohibiting "new investment, technical assistance and transfers of technologies, equipment and services related to these areas, in particular related to refining, liquefaction and liquefied natural gas technology" (Farzanegan, 2011). The Financial Times estimates that oil production in Iran decreased to about 300,000 barrels per day due to international sanctions [4]. As a result of these new sanctions, Iran is going to lose $14 billion in annual oil sales in the next five years.[5]

In response to increasing debates on imposing an oil embargo against Iran, the Iranian Government has warned to close the Strait of Hormuz. Hormuz is the world's most important oil chokepoint with a daily oil flow of almost 17 million barrels (bbl/d) in 2011. 85% of the oil transited via Hormuz goes to the Asian markets.[6] These potential threats and the likely Iranian oil embargo may reduce the supply of Iranian oil in global markets. This supply shock raises a question: How do oil prices response to the Iranian oil production and export shocks?

[2] There are preliminary news on a conditional agreement of Japan (the second largest importer of Iranian oil) to reduce the oil imports from Iran. The Indian Government (as the third largest importer of Iranian oil) has asked its refineries to reduce their dependency on Iranian oil, finding other alternatives. For more details see http://www.bbc.co.uk/news/world-asia-16523422 and http://www.bbc.co.uk/persian/business/2012/01/120111_ll_india_iran_oil_sanction.shtml

[3] See http://www.firstpost.com/politics/new-sanctions-on-iran-pose-problem-for-indias-oil-payments-174761.html

[4] http://www.ft.com/cms/s/0/8a250ad6-6691-11df-aeb1-00144feab49a.html

[5] http://www.defenddemocracy.org/project/iran-energy-project/

[6] http://www.eia.gov/todayinenergy/detail.cfm?id=4430

The main hope of the western countries for the successful implementation of an oil embargo against Iran is the extra production capacity of Saudi Arabia. Saudi Arabia produces on average approximately 10 million bbl/d, while its maximum production capacity is approximately 12 million bbl/d. It seems that in the case of maximum production, Saudi Arabia may be able to cover the shortage of Iranian oil exports in the markets. Can this possibility reduce the sensitivity of the oil prices in the case of shocks in the Iranian oil supply?

Previous case studies of Iran focus on the effects of oil price shocks on different aspects of the Iranian economy (see Farzanegan and Markwardt, 2009; Farzanegan, 2011; and Esfahani et al., 2009). This paper adds to the literature by examining a Toda–Yamamoto (see Toda and Yamamoto, 1995) version of the Granger causality relationship between international oil prices and Iran's oil supply. Our main results show the lack of any Granger causality between the levels of Iranian oil supply and international real oil prices. In other words, there is no empirical evidence on the importance and usefulness of the historical data on Iranian oil production for the prediction of crude oil prices. To compare and in contrast to the case of Iran, there is unidirectional Granger causality from the Saudi Arabian oil production to the international oil prices.

The rest of the paper is organized as follows. Section 2 presents a brief review of literature on macroeconomic impacts of oil shocks. Section 3 presents data, methodology and results. Section 4 concludes the paper.

2- A brief review of literature

Previous studies examine the role of oil price shocks on different indicators of the oil importing and exporting countries. The main focus was on the major oil consuming countries. For example, Darby (1982) and Hamilton (1983) for the US economy; Burbridge and Harrison (1984), Gisser and Goodwin (1986), Hooker (1996), Rotemberg and Woodford (1996), Jimenez-Rodriguez (2008) and Elder and Serletis (2010) for the oil shocks and industrial production in a group of industrialized economies; Blanchard and Gali (2010) for the comparison of the current response of inflation and output to oil shocks to those of the 1970s; Cologni and Manera (2008) and Chen (2009) for the oil shocks-inflation nexus; Park and Ratti (2008) and Bachmeier (2008) for the oil shocks-stock market nexus. In addition, some studies examined oil exporters, for example, Berument et al. (2010) for a group of the Middle East and North African countries; Iwayemi and Fowowe (2011) for the case of Nigeria; and Mohanty et al. (2011) for the case of Gulf Corporation Council countries.

3- Methodology, data and estimation results

To examine the dynamic relationship between Iran's oil production and international oil prices, we made use of two variables: logarithm of daily oil production of Iran (bbl/d) and logarithm of spot West Texas Intermediate oil price ($ per bbl)[7]. The logarithmic transformation tends to reduce heteroscedasticity and increase the stationarity of the variables. The oil prices are in constant prices of 2011 dollars. The sample period consists of monthly observations from January 1973 to September 2011. Our monthly observations are seasonally adjusted, removing cyclical seasonal movements from data and extracting the underlying trend component of the series. The source for international oil prices is the data of the Federal Reserve Bank of St. Louis (FRED, 2012) and the source for the Iranian daily oil production is the data of the US Energy Information Administration International Petroleum Monthly (IPM, 2011).

The principal aim of this paper is to conduct causality tests between the Iranian oil production levels and the international oil prices. In order to assess the causality between our variables, we use the Toda–Yamamoto (TY hereafter) procedure (Toda and Yamamoto, 1995). This procedure is robust to the integration and cointegration properties of the variables. Following the TY approach, we can set up a VAR in levels and implement Granger causality and apply

[7] We do not have access to the monthly oil exports of Iran. The OPEC annual statistics provides annual observations for the oil exports. However, we expect a high correlation between export and production figures of crude oil.

the standard Wald criterion in levels of variables even for the case of integrated or cointegrated variables. The possibility of estimating VAR in levels regardless of the degree of integration of variables in the TY approach reduces the information loss due to differencing variables. This procedure is also more flexible in considering arbitrary levels of integration (Soytas et al., 2009 and Alguacil et al., 2002).

Initially, we examine the degree of integration in our data, using the ADF test (Dicky and Fuller, 1979) and the PP test (Phillips and Perron, 1988). The unit root tests show that the logarithm of oil prices and the logarithm of Iran's oil production are integrated in the first degree (the maximum degree of integration m=1). In the next step, we set up following an unrestricted VAR model with the order of p:

$$y_t = \Sigma_{i=1}^{p} A_i . y_{t-i} + B.X_t + e_t \tag{1}$$

where y_t is a vector of endogenous variables in levels (logarithm of seasonally adjusted real spot oil prices and Iran's oil production), X_t is a vector of exogenous variable (constant term). A_i and B are coefficient matrices and p is the optimum lag number. On the basis of sequential modified LR test statistics, the optimum lag number is 5. Upon finding an optimum lag length (5), we make sure that the VAR is well-specified by testing the dynamic stability and residual serial correlation in the estimated VAR model. The VAR stability condition test shows that no roots of characteristic polynomial lies outside of the unit circle and VAR satisfies the stability condition. The VAR residual serial correlation LM test also shows that there is no serial correlation up to 12 lags. The Johansen cointegration test (Trace type) shows that there is some weak evidence for a long run relationship between these two variables.[8] Once the optimum lag length (p) has been found and the validity of the VAR examined, the causality

[8] There is no evidence for a long run relationship between these two variables on the basis of the Maximum Eigenvalue (*Max. Eig.*) criterion.

test is formulating as zero restrictions on the coefficients of the lags of the other variables by a χ^2-test statistic (Alguacil et al., 2002).

According to the TY approach, we need to determine the maximum degree of integration in our dataset (*d-max*, which is 1 in our oil prices and Iran's oil production variables). Then we over-fit the model in levels with the addition of *d-max* lags (a VAR (k)) in which $k=p+d$. The standard Wald test is then applied on the first p coefficient matrices using the standard χ^2-statistics. The Wald test statistics will be asymptotically χ^2 distributed with p degree of freedom, under the null of *no Granger causality*. Rejection of the null hypothesis means a rejection of Granger non-causality. In other words, a rejection supports the presence of Granger causality. The TY Granger causality test results are presented in Table 1.

Table 1. Toda–Yamamoto Granger Causality (Oil Prices and Iran's Oil Production)

	Null Hypothesis	Chi-q (*dof*)	probability
a	Log level of Iran's daily oil production *does not Granger Cause* Log level of real crude oil prices	1.93 (5)	0.85
	Log level of real crude oil prices *does not Granger Cause* Log level of Iran's daily oil production	1.87 (5)	0.86

Note: Sample period is January 1973- September 2011 (459 observations). Both variables are seasonally adjusted.

The results in Table 1 show strong evidence against any Granger causality relationship between the Iranian oil production and international oil prices. In other words, we cannot explain current and future values of crude oil prices on the basis of the past information on the Iranian crude oil production and vice versa. For comparison, we have implemented the same TY Granger causality test using the daily oil production of Saudi Arabia. Initially, we examine the maximum degree of integration which is m=1. We set up a VAR model and determine the optimum lag length of 4 on the basis of the FPE (Final Prediction Error) and the AIC (Akaike information criterion). Using a Johansen cointegration test, we find weak evidence in the long run relationship between the Saudi oil production and oil prices. The

VAR stability test and the residual serial correlation LM test show satisfactory performance. Finally, we proceed to test the TY Granger causality on the basis of a VAR (p+d-max=4+1) model in levels as explained earlier. Table 2 shows the Granger causality results for the case of Saudi Arabia.

Table 2. Toda–Yamamoto Granger Causality (Oil Prices and Saudi Arabian Oil Production)

	Null Hypothesis	Chi-q (dof)	probability
a	Log level of Saudi Arabia's daily oil production *does not Granger Cause* Log level of real crude oil prices	12.42 (4)	0.01
	Log level of real crude oil prices *does not Granger Cause* Log level of Saudi Arabia's daily oil production	5.29 (4)	0.25

Note: Sample period is January 1973- September 2011 (460 observations). Both variables are seasonally adjusted.

From Table 2, we notice a considerable difference. There is strong evidence (at 99% confidence interval) that the Saudi Arabian oil production Granger causes international oil prices. In contrast to the Iranian case, the past information on the Saudi oil production is useful to predict the current and future changes in global crude oil prices.

4- Concluding remarks

There is increasing concern on the possible consequences of the oil embargo on Iran for international oil markets. In particular, policy makers are interested in the effects of shocks in the Iranian oil supply on the international oil prices. Using monthly observations from 1973 to 2011, we analyze the existence of causality between the Iranian oil production and international crude oil prices. We apply the modified Wald Granger causality test introduced by Toda and Yamamoto (1995). Our results show that there is no Granger causality relationship between the Iranian oil production and international oil prices. Past information on the Iranian oil production is not a useful source of data to predict the current and future oil prices. For comparative analysis, we examined the same causality relationship between the

Saudi Arabian oil production and international oil prices. We find a highly statistically significant causal relationship between the Saudi oil production and international oil prices. The policy implications of these results are straightforward. Plans to sanction Iranian oil and the reduction of Iranian oil supply in the markets may not have a critical impact on current and future international oil prices. However, the Iranian Government may respond aggressively to the implementation of an oil emabrgo by closing the Hurmoz Strait. In the latter case, the oil supply of other countries in the Persian Gulf region can also be affected. In this case, we may expect to observe a significant response from international oil prices.

References

Alguacil, M.T., Cuadros, A., Orts, V., 2002. Foreign direct investment, exports and domestic performance in Mexico: a causality analysis. Economics Letters 77, 371–376.

Bachmeier, L., 2008. Monetary policy and the transmission of oil shocks. Journal of Macroeconomics 30, 1735-1755.

Berument, H., Ceylan, N.B., Dogan, N., 2010. The impact of oil price shocks on the economic growth of the selected MENA countries. The Energy Journal 31, 149-176.

Blanchard, O.J., Gali, J., 2010. The macroeconomic effects of oil price shocks: why are the 2000s so different from 1970s?, in: Gali, J., Gertler, M. (Eds.), International Dimensions of Monetary Policy. University of Chicago Press, Chicago, IL, pp. 373-428.

Burbridge, J., Harrison, A., 1984. Testing for the effects of oil-prices rises using vector autoregressions. International Economic Review 25, 459–484.

CBI, 2012. Economic Time Series Database. Central Bank of Iran. Available at: http://tsd.cbi.ir/

Chen, S-S., 2009. Oil price pass-through into inflation. Energy Economics 31, 126-133.

Cologni, A., Manera, M., 2008. Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries. Energy Economics 30, 856-888.

Darby, M.R., 1982. The price of oil and world inflation and recessions. American Economic Review 72, 738–751.

Dickey, D.A., Fuller, W.A., 1979. Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association 74, 427–431.

Elder, J., Serletis, A., 2010. Oil price uncertainty. Journal of Money, Credit, and Banking 42, 1137-1159.

Esfahani, H.S., Mohaddes, K., Pesaran, H., 2009. Oil exports and the Iranian economy. IZA Discussion Papers No. 4537, Bonn.

Farzanegan, M.R., 2011. Oil revenue shocks and government spending behavior in Iran. Energy Economics 33, 1055-1069.

Farzanegan, M.R., Markwardt, G., 2009. The effects of oil price shocks on the Iranian economy. Energy Economics 31, 134-151.

Faucon, B., 2012. New Sanctions Target Iran Oil Sales. The Wall Street Journal (5th January). Available at: http://online.wsj.com/article/SB10001424052970203471004577142262365335718.html

FRED, 2012. Federal Reserve Economic Data, Federal Reserve Bank of St. Louis: Spot Oil Price: West Texas Intermediate (OILPRICE), Available at: http://research.stlouisfed.org/fred2/series/OILPRICE

Gisser, M., Goodwin, T.H., 1986. Crude oil and the macroeconomy: tests of some popular notions. Journal of Money, Credit and Banking 18, 95–103.

Hamilton, J.D., 1983. Oil and the marcoeconomy since World War II. The Journal of Political Economy 91, 228–248.

Hooker, M.A., 1996. What happened to the oil price–macroeconomy relationship? Journal of Monetary Economics 38, 195–213.

IPM, 2012. International Petroleum Monthly. The US Energy Information Administration. Available at: http://www.eia.gov/ipm/

Iwayemi, A., Fowowe, B., 2011. Impact of oil price shocks on selected macroeconomic variables in Nigeria. Energy Policy 39, 603-612.

Jimenez-Rodriguez, R., 2008. The impact of oil price shocks: evidence from the industries of six OECD countries. Energy Economics 30, 3095-3108.

Mohanty, S.K., Nandha, M., Turkistani, A.Q., Alaitani, M.Y., 2011. Oil price movements and stock market returns: Evidence from Gulf Cooperation Council (GCC) countries. Global Finance Journal 22, 42–55.

OPEC, 2011. The OPEC Annual Statistical Bulletin (Web Version). Vienna, Austria.

Park, J., Ratti, A., 2008. Oil price shocks and stock markets in the U.S. and 13 European countries. Energy Economics 30, 2587-2608.

Phillips, P.C.B., Perron, P., 1988. Testing for a unit root in time series regression. Biometrika 75, 335–346.

Rotemberg, J.J., Woodford, M., 1996. Imperfect competition and the effects of energy prices. Journal of Money, Credit and Banking 28, 550–577.

Soytas, U., Sari, R., Hammoudeh, S., Hacihasanoglu, E., 2009. World oil prices, precious metal prices and macroeconomy in Turkey. Energy Policy 37, 5557–5566.

Toda, H.Y., Yamamoto, T., 1995. Statistical inference in Vector Autoregressions with possibly integrated processes. Journal of Econometrics 66, 225-250.